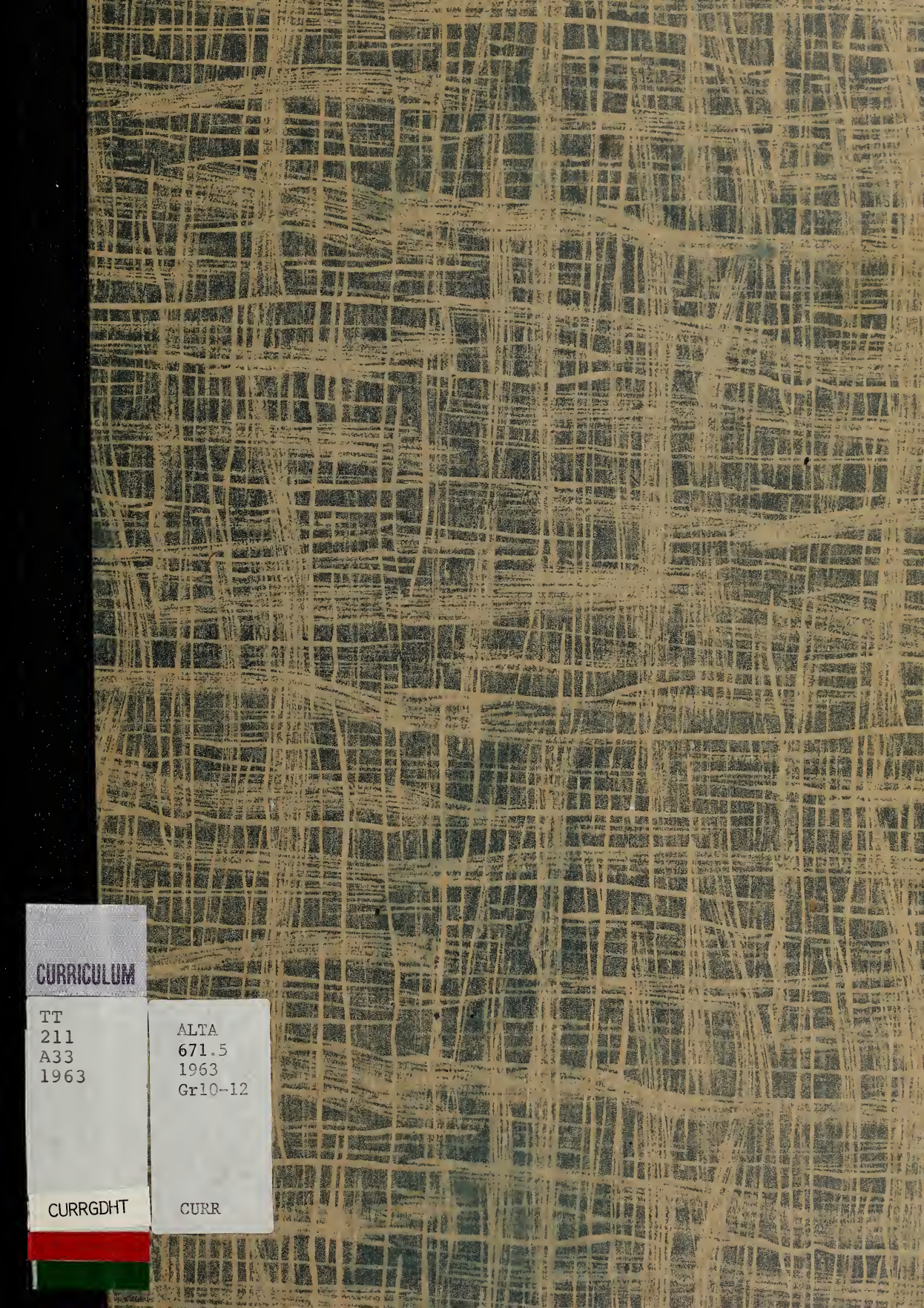

CURRICULUM

TT
211
A33
1963

CURRGDHT

ALTA
671.5
1963
Gr10-12

CURR

TION LIBRARY

ATION LIBRARY
ERSITY OF ALBERTA

CURRICULUM GUIDE

CURRICULU

Senior High School

CURRICULUM GUIDE

Vocational Series

WELDING 12 - 22 - 32

(Interim Edition, September, 1963)

Province of Alberta

Department of Education

CURRICULUM
EDUCATION LIBRARY

Digitized by the Internet Archive
in 2015

https://archive.org/details/welding122232voc00albe

CONTENTS

Foreword . . . . . Page 3

Objectives . . . . . Page 4

General Information . . . . . Page 5

Welding 12 Outline . . . . . Page 9

Welding 22 Outline . . . . . Page 25

Welding 32 Outline . . . . . Page 44

Reference Books . . . . . Page 59

COURSE CREDIT VALUES

Welding 12 - 5 credits

Welding 22 - 15 credits

Welding 32 - 15 or 20 credits

One credit corresponds to a minimum of 40 minutes of instruction time per week.

FOREWORD

The science of welding is by no means new since its origin dates back to the very beginning of man's knowledge and use of metal. Like many other sciences and skills, progress in welding of metal advanced very slowly because of the primitive methods used and the lack of technical knowledge. However, toward the end of the 19th century, the science of welding surged forward and continues to do so today at an ever increasing rate. Welding today has become one of the most important and widely used methods for joining metals. There is no doubt that an interesting and challenging future lies ahead for those who undertake the study of the science of welding and the development of skill in this field.

GENERAL OBJECTIVES

1. To impart to the student, a knowledge of the role that welding plays in industry today and the opportunities that exist in this field.

2. To equip a student with sufficient skill and knowledge such that he will be highly employable in the welding trade.

3. To enable a student entering the welding apprenticeship program, to advance at an accelerated rate on the basis of his proven ability on the job.

SPECIFIC OBJECTIVES

1. To enable students to use welding equipment efficiently, accurately and safely.

2. To develop desirable habits concerning safety, good working relationships and proper use of time and material.

3. To develop the skills and knowledge required to prepare and interpret accurate work drawings.

4. To familiarize students with the different types of metal used in industry and the problems related to the welding or brazing of these metals.

GENERAL INFORMATION

1. Course Credit Values

   a. Welding 12 - 5 credits
   b. Welding 22 - 15 credits
   c. Welding 32 - 15 or 20 credits

2. Safety Program

Every shop must have an effective safety program. In the welding shop, particular attention must be given to those safety precautions required by the industry: adequate protection for yourself as well as those with whom you are working; cleanliness of shop and personnel maintained at a high standard; students properly clothed for the work; etc. The shop organization must be such as to ensure this very important phase of the shop program.

A good safety program features the following: regular, consistent and thorough instruction; constant vigilance and checking by the instructor; safety posters, adequate first aid equipment; an instructor who is trained and up-to-date in first-aid methods; adequate working space, routine report on all accidents however minor; machines, tools and equipment in approved working condition; a safety-conscious group of students as well as a careful instructor.

3. Instructor's Records

The instructor should keep accurate up-to-date records of:

(a) Student enrolment and attendance
(b) Student accounts
(c) Student work activity
(d) Theory covered
(e) Tests given
(f) Student achievement
(g) Inventory of all equipment

4. Student Records

Instructors should ensure that the student develops and maintains a neat and accurate record of:

(a) Notes on theory
(b) Daily shop activities (time cards)
(c) Formal reports

5. Enrolment

The maximum enrolment for a welding class should not exceed 16 students. Two classes may easily be combined for the presentation of theory, however.

6. Guidance and Vocational Information

Instructors must assume responsibility in their trade area to ensure that students and guidance officials are aware of the local situation. It is essential that instructors be active, interested and informed regarding the opportunities in the trade.

7. Projects

It is expected that some projects will be used in Grade X and to a limited degree in Grades XI and XII as vehicles of instruction and as a means of securing and retaining student interest. The onus is on the instructor to ensure that the projects selected involve only those operations specified in the course outline, and that the time required to complete the project does not encroach upon the time needed to learn other skills, operations and knowledge.

8. Instructions on the Use of the Following Guide

The course outline is divided into three columns, designated; Operations, Basic Information and References. The first column outlines the type of activity performed by the students in the shop. The second column refers to the essential knowledge upon required to adequately carry out the operations outlined in the first column. It also includes knowledge of a general nature regarding the trade and the industry, that is not directly related to the operations. The third column lists numbers which correspond to the references listed in the back of this curriculum guide.

The reference column has not been completed. Instructors are requested to insert the reference which they consider most suitable for the particular topics outlined. It would be desirable if instructors would also note the time spent on the various topics. All of this information will be extremely valuable to the curriculum committee in revising the curriculum guide.

We ask that instructors keep two copies of this outline, one of which can be returned to the Department with the instructors notations as mentioned above and one for the instructor's own records.

It is not recommended that any prescribed text be purchased by the students, but rather that the instructors prepare notes for distribution. The reference books listed in the back of the guide should be in the school library with those marked with an asterisk in sufficient quantity to provide one copy for each member of the largest class.

NOTE: Whereas Welding 12 is an exploratory course open to all Grade X students, the Welding 22 and 32 courses are definitely vocational and only those students who have displayed ability and aptitude for the program, should be encouraged to continue. It is not fair to the student to permit him to continue in a program which demands a large portion of his school time, and in which the instructor and/or the guidance counsellor feel that he has little chance of success.

The following three-year welding course is designed for the Vocational High Schools of Alberta. To facilitate transfer from one Vocational School to another and to insure Provincial standards, it is recommended that the outline be followed closely.

Welding 12 - Grade 10 - 5 credits (133 hours)

Welding 22 - Grade 11 - 15 credits (400 hours)

Welding 32 - Grade 12 - 15 or 20 credits (400-532 hours)

The work of the three-year program is divided into 36 units. Instead of repeating the writing of a topic, it will be referred to by number, e.g., 22-5-3 refers to Course 22 - Grade 11, Unit 5 (Brazewelding and Brazing), Topic 3 (Brazing aluminum alloys). About 40% of the time should be spent on theory and drafting and 60% on practice.

The overall time for the units are to be considered as mandatory. The time indicated for individual items within the units are only approximate and suggested for guidance of the instructor.

WELDING 12 - OUTLINE

(First year of three-year Vocational Welding Program)

(5 credits - 133 hours)

UNIT I - TRADE STUDY - 5 HOURS

Operations	Basic Information	References
Famialization tour of the shop, learning shop procedure and routine.	NOTE: This unit to be split between the beginning and the end of the term. a. History and importance of welding trade b. Duties c. Qualifications d. Training e. Earnings - its span f. Advancement g. Related occupations h. Advantages and disadvantages i. Trends for future	

UNIT II - GENERAL SHOP PRACTICE - 24 HOURS

Contents

1. Cutting metal to a line (2 hours)
2. Drilling a hole (4 hours)
3. Using an electric drill (2 hours)
4. Using a grinder (2 hours)
5. Using a punch (1 hour)
6. Reconditioning a cold chisel (2 hours)
7. Using a hammer (1 hour)
8. Installing screws (2 hours)
9. Fastening a bolt and nut (1 hour)

10. Using clamping devices (1 hour)

11. Using the power hacksaw (2 hours)

12. Shearing sheet metal and plate (1 hour)

13. Extinguishing a fire (1 hour)

14. Storing material in a rack (1/2 hour)

15. Personal and shop cleanliness (1/2 hour)

16. General safety (1 hour - constant vigil)

ote: It is not intended that this unit be taken in a block but rather as it is needed. The same applies to all other units in the three-year course.

Operations	Basic Information	References
. Cutting metal to a line with hand hacksaw	a. Types and sizes of saw frames	
	b. Length and types of blades	
	c. Teeth per inch in relation to metal thickness	
	d. Need for variety of blades	
	e. Correct installation and tension	
	f. Strokes per minute	
	g. Posture and correct handling	
	h. Causes of blade damage	
	i. Storage of blades and frames	
2. Drilling a hole	a. Cutting angle of drill bits and how to check	
	b. Types of steel used	
	c. How to sharpen a twist drill	

Operations	Basic Information	References
	d. Need for coolant when drilling or sharpening	
	e. Types of coolants	
	f. Correct pressure when drilling	
	g. Use of a pilot hole and correction	
	h. Correct cutting speed Dependence of r.p.m. on size	
	i. How to avoid breakage	
	j. Need for centre punching	
	k. Dressing centre punch	
	l. Stack drilling	
. Using an electric drill	a. Types, features, sizes, advantages, disadvantages and safe operation	
	b. Importance of grounding and knowing voltage	
	c. Care of electric drills	
. Using a grinder (a) Pedestal (b) Portable	a. Types of grinder	
	b. Mounting wheels	
	c. Adjusting tool rest	
	d. Truing stones	
	e. Trade specifications for wheels as relates to cutting action and material	
	f. Recommended r.p.m.	

Operations	Basic Information	References
	g. Safe use - pressure, goggles, face shields, control of portable grinder and wire wheel area to be used	
	h. Testing wheels for cracks	
5. Using a punch to remove rivets	a. Types of punches	
	b. Conditioning punches	
6. Reconditioning a cold chisel	a. Types and sizes of chisels	
	b. Sharpening flat chisels	
	c. Conditioning mushroom end	
7. Using a hammer	a. Types and proper use of hammers	
	b. Sizes and weights	
	c. Material used in hammers and handles	
	d. Wedges	
. Installing screws	a. Types of screw drivers	
	b. Steel used in screw drivers	
	c. Handles	
	d. Reconditioning a broken screw driver	
	e. Types of bits	
	f. Use of power screw drivers	

Operations	Basic Information	References
. Fastening a bolt and nut	a. Trade specifications and terminology of bolts and threads	
	b. Types of wrenches, advantages and disadvantages	
	c. Correct and safe usage	
. Using clamping devices to: a. Prevent buckling b. Reduce distortion c. Assure alignment	a. Types and features of clamps	
	b. Methods of clamping	
	c. Effect of wild spatter on clamp	
. Using a power hack saw	a. Types	
	b. Specifications of cutting blades and pitch	
	c. Adjustment for straight cut and mitre cut	
	d. Hydraulic pressure	
	e. Clamping	
	f. Cutting angle iron, rod and pipe	
	g. Cutting fluid systems	
. Shearing sheet metal and plate	a. Identification of metal to be cut	
	b. Types of shears for straight and curved cuts	
	c. Limitations due to gauge and type of metal	
	d. Shears for heavier sheet metal and plate - Samson, Beverley	

Operations	Basic Information	References
3. Extinguishing a fire	a. Types of extinguishers	
	b. Types of fires	
	c. Fire prevention	
4. Storing material in a rack	a. Types of racks	
	b. Precautions necessary in loading and unloading	
5. Personal and shop cleanliness	a. Reasons	
6. General safety	a. How and why	

OXY-ACETYLENE WELDING

Unit III - USING AND STORING EQUIPMENT - 13 HOURS

Contents

1. History of oxy-acetylene welding (1/2 hour)
2. Handling and storing oxygen cylinders (2 hours)
3. Handling and storing acetylene cylinders (2 hours)
4. Handling and storing cylinders of other gases (1/2 hour)
5. Generating acetylene gas (1/2 hour)
6. Setting up equipment (2 hours)
7. Using oxy-acetylene equipment (3 hours)
8. Disassembling and storing (3 hours)

Operations	Basic Information	References
1. Discussion	a. History of oxy-acetylene	
2. Safe handling and storing oxygen cylinders	a. Capacity in cu. ft. of cylinders	
	b. Pressure	
	c. Sizes and weights of cylinders	
	d. Importance of proper storing, handling and occupational hazards	
	e. Advantages of manifold system	
	f. Construction and operation of valve	
	g. Shop pipeline distribution	
3. Handling and storing acetylene cylinders	a. Cylinder filling	
	b. Purpose of acetone content	
	c. Safety plugs	
	d. Construction and operation of valves	
	e. Capacity in cu. ft.	
	f. Different sizes and weights of cylinders	
	g. Advantages of manifold system - precaution in use	
	h. Cylinder pressure	
	i. Importance of proper storing and handling	

Operations	Basic Information	References
4. Handling and storing cylinders of other gases	a. Types and precautions	
5. Generating acetylene gas; lab demonstration	a. Calcium carbide water reaction	
	b. Storage of calcium carbide	
	c. Economics of gas production	
	d. Safe practices	
	e. Ice formation	
	f. Traps	
	g. Advantages and disadvantages; disposal of spent carbide	
6. Setting up equipment	a. Reasons for securing	
a. Positioning and securing cylinders	b. Reasons for 'cracking' valves	
b. 'Cracking' cylinder valves	c. Construction and operation of regulators	
c. Attaching regulators	d. Pre-set, single stage and two-stage regulators	
d. Connecting hoses to regulators	e. Function of adjusting screw	
e. Connecting torch handle to hoses	f. Identifying acetylene equipment	
f. Attaching welding tip to handle	g. Hose sizes	
g. Opening cylinder valves	h. Blowing out hoses	
h. Adjusting working pressure	i. Features and functions of torch handles - H.P; L.P; M.P; or E.P.	
i. Balancing equal pressure torches	j. Types of welding tips and methods of attaching	
j. Testing for leaks	k. Opening cylinder valves	

Operations	Basic Information	References
	l. Adjusting for working pressure	
	m. Testing for leaks	
	m. Opening acetylene cylinder valve	
	o. Danger of using oil with oxygen	
7. Using oxy-acetylene equipment	a. Gas pressure in relation to tip size	
a. Lighting the torch	b. Purpose of three kinds of flame	
b. Adjusting to correct flame	c. Temperatures of flames	
	d. Cleaning tips	
	e. Shapes of cones	
	f. Terms used in connection with welding	
	g. Reconditioning a damaged tip	
	h. Flashbacks and backfires	
	i. Care, maintenance and use of goggles, protective equipment and personal clothing	
	j. Repairing hoses	
. Disassembling and storing oxy-acetylene equipment	a. Importance of sequence in turning off torch valves	
a. Turning off torch	b. Method of closing cylinder valves	
b. Closing cylinder valves	c. Sequence for releasing line pressure - danger of releasing free acetylene	
c. Releasing pressure in lines		

Operations	Basic Information	References
d. Disconnecting tip and handle	d. Disconnecting tips, handle, hoses	
e. Disconnecting hoses	e. Taking down regulators	
f. Taking down regulators	f. Reasons for safety caps	
	g. Handling cylinders	
g. Securing safety caps	h. Storing	
h. Storing in dry clean place	i. Coiling hoses	
	j. Relieving spring pressure regulator valve seats	
i. Simple reconditioning of gauges	k. Pipeline regulators, line valves, check valves bursting discs	

NIT 1V - WELDING FERROUS METALS - 42 HOURS

Contents

1. Preparing job (2 hours)
2. Running a bead (10 hours)
3. Welding sheet metal (10 hours)
4. Welding steel plate (20 hours)

Operations	Knowledge
1. Preparing job and equipment	a. Dressing in preparation for welding; gloves, goggles, other clothes
	b. Identification of metals
	c. Necessity of cleaning metals
	d. Necessity of clamping work
	e. Joint preparation - bevelling, etc.
2. Running a bead	a. Size of tip
a. Without filler rod on 14 ga M/S	b. Type of filler rod
	c. Size of filler rod
b. With filler rod on 14 ga M/S	d. Need for preparation
	e. Movement of torch
	f. Distance of central cone of flame from work
	g. Speed of travel
	h. Puddle formation
	i. Angle and inclination of tip with work
	j. Size of bead
	k. Need for welding in different positions
	l. Forehand technique
	m. Effect of different flame settings on metal
. Welding sheet metal	a. Spacing of tack weld in relation to metal thickness
a. Butt weld 16 ga M/S with filler rod (flat) and 45^{o}	b. Appearance of finished weld
	c. Importance of forehand technique only

Operations	Knowledge
	d. Method of obtaining penetration and correct reinforcement
	e. Effect of heat on metals; expansion and contraction
	f. Backstep method
4. Welding mild steel plates	a. Recommended tip size
a. Butt weld 16 ga M/S (Flat and 45°)	b. Size of filler rod
b. Butt weld 1/8 ga M/S (Flat and 45°)	c. Preparation
c. Butt weld 3/16 ga M/S (Flat and 45°)	d. Spacing and tack welding
d. Open corner weld 16 ga M/S (Flat and 45°)	e. Preventing undercut and overlap
e. Open corner weld 1/8 M/S (Flat and 45°)	f. Obtaining proper fusion
f. Open corner weld 3/16 ga M/S (Flat and 45°)	

UNIT V - BRAZEWELDING AND BRAZING

Contents

1. Brazewelding mild steel (5 hours)

Operations	Knowledge
1. Brazewelding mild steel (flat)	a. Definition of brazewelding
	b. Characteristics and properties of filler metal
	c. Preparation of base metal
	d. Flux
	e. Recommended flame setting
	f. Tinning
	g. Advantages and limitations of this process
	h. Recommended sequence
	i. Ventilation

ELECTRIC ART WELDING

NIT VI - INSTALLING AND USING WELDERS - 14 HOURS

Contents

1. History (2 hours)
2. Using DC welders (4 hours)
3. Using AC transformer welder (4 hours)
4. Using DC rectifier welder (4 hours)

Operations	Basic Information	References
. Discussion	a. History of electric arc welding	
. Using D.C. welder (electric motor driven)	a. Identification of make and capacity	
	b. Characteristics of available power	
	c. Principles of direct current	
	d. Advantages and disadvantages of D.C. welders	
	e. Capacity and use of cables and electrode holders	
. Using A.C. transformer welder	a. Identification of make and capacity	
	b. Principles of alternating current	
	c. Advantages and disadvantages of A.C. transformer welders	
	d. Capacity and use of cables and electrode holders	
	e. Switches and controls	

Operations	Basic Information	References
Using D.C. rectifier welder	a. Identification of make and capacity	
	b. Elementary electricity	
	c. Switches and controls	
	d. Advantages of selenium and other rectifiers	
	e. Capacity and use of cables electrode holders	
	f. Advantages and disadvantages of D.C. rectifier welders	

IT VII - WELDING FERROUS METALS - 25 HOURS

Contents

1. Preparing job (5 hours)
2. Running a bead (10 hours)
3. Welding mild steel plate (10 hours)

Operations	Basic Information	References
Preparing job and equipment	a. Dressing in preparation for welding; face and eye protection, gloves, other clothes	
	b. Necessity of cleaning metal	
	c. Necessity of clamping work	
	d. Grounding work	
	e. Effect of thickness on edge preparation	

Operations	Basic Information	References
	f. Techniques which minimize buckling	
	g. Importance of identifying metal	
Running a bead	a. Selection of the correct type of electrode	
a. Padding $\frac{1}{4}$ x 4 x 4 coupon using E6010, E6011, E6012, E6013, E6014 electrodes on DC and AC machines	b. Heat control - voltage and amperage	
	c. Method of striking an arc	
	d. Distance of electrode from plate	
	e. Starting a bead	
	f. Speed of forward movement	
	g. Stopping and restarting a bead	
	h. Core wire composition	
	i. Flux or coating composition and use	
	j. Importance of cleaning weld	
	k. Chipping hammer - importance of correct type	
	l. Safety - arc flash, clothing, eye protection, electric shock	

Operations	Basic Information	References
. Welding mild steel plate a. $\frac{1}{4}$" butt weld (flat) b. 3/16" butt weld (flat) c. 1/8" butt weld (flat)	a. Importance of material classification b. Classification and sizes of electrodes c. Difference between A.C. and D.C. Straight and reverse polarity welding d. Machine setting e. Acceptable size and shape of bead f. Single and multi-pass welds	

IT VIII - METALLURGY (5 HOURS)

Operations	Basic Information	References
	a. Chemistry of flame $C_2H_2+O_2=2CO+H_2$ $2CO+O_2=2CO_2$ $2H_2+O_2=2H_2O$ b. Effect of three types of flame on mild steel c. Melting points d. Effects of heat on metals e. Effects of quenching welds	

WELDING 22 OUTLINE

(Second year of three-year Vocational Welding Program)
(15 credits - 400 hours)

UNIT I - GENERAL SHOP PRACTICE - 5 HOURS

Contents

1. Brief review of 12 - 1 (2 hours)
2. Power sanding (1 hour)
3. Filing (1 hour)
4. Storing material (1 hour)

Operations	Basic Information	References
. Review 12 - 1	a. Emphasis on safety efficiency, cleanliness, pride in workmanship	
. Installing and using a sanding disc	a. Trade specifications for sanding discs. Angle of disc to work piece	
. Filing as necessary in repair work and preparing test specimen	a. Preventing vise marks b. Positioning work c. Types of files and cut d. Use of chalk when filing e. Wire brushes and file cards f. File care g. Correct posture, speed, and pressure h. Importance of identifying metals	

Operations	Basic Information	References
4. Storing material	a. Horizontal and vertical racks	
	b. Securing material	
	c. Weight of material	
	d. Safe loading and unloading	

UNIT 11 - USING AND STORING OXY-ACETYLENE EQUIPMENT (Review) - 8 HOURS

Contents

1. History of oxy-acetylene welding (1 hour)
2. Handling and storing oxygen cylinders (1 hour)
3. Handling and storing acetylene cylinder (1 hour)
4. Handling and storing cylinders of other gases (1 hour)
5. Generating acetylene gas (1 hour)
6. Setting up equipment (1 hour)
7. Using oxy-acetylene equipment (1 hour)
8. Disassembling and storing (1 hour)

Operations	Basic Information	References
Review 12 - 2 - 1	a. Capacity in cu. ft. of cylinders for both gases	
Review 12 - 2 - 2	b. Cylinder pressures for both gases	
Review 12 - 2 - 3	c. Different sizes and weights of cylinders	
Handling and storing cylinders of other gases	d. Importance of proper storing and handling	

Operations	Basic Information	References
5. Review 12 - 2 - 4		
6. Review 12 - 2 - 5		
7. Review 12 - 2 - 6		
8. Review 12 - 2 - 7		
9. Review 12 - 2 - 8		

UNIT 111 - WELDING FERROUS METALS 115 HOURS

Contents

1. Preparing job (5 hours)
2. Running a bead (10 hours)
3. Welding sheet metal (20 hours)
4. Welding steel plate (50 hours)
5. Welding cast iron (20 hours)
6. Welding cast steel (10 hours)

Operations	Basic Information	References
Preparing job	a. Review 12 - 3 - 1	
	b. Blueprint reading and interpreting welding symbols to determine type of joint	
	c. Importance of bevelling heavy plate	
Running a bead	a. Review 12 - 3 - 2	
	b. Backhand technique	
	c. Peening to reduce distortion	

Operations	Basic Information	References
Welding sheet metal	a. Review 12 - 3 - 3	
a. Butt weld 16 ga M/S (flat)		
b. Butt weld 16 ga M/S (vertical)		
c. Butt weld 16 ga M/S (horizontal)		
d. Butt weld 16 ga M/S (overhead)		
Welding M/S plates	a. Review 12 - 3 - 4 a to f	
a. Butt weld 1/8 in. M/S (flat)	b. Using weld gauge	
b. Butt weld 1/8 in. M/S (vertical)		
c. Butt weld 1/8 in. M/S (horizontal)		
d. Butt weld 1/8 in. M/S (overhead)		
e. Butt weld 3/6 in. M/S (flat)		
f. Butt weld 1/8 in. M/S (vertical)		
g. Butt weld 1/8 in. M/S (horizontal)		
h. Butt weld 1/8 in. M/S (overhead)		
i. Fillet weld 1/8 in. all positions		
j. Lap weld 1/8 in. all positions		
k. Open corner weld 1/8 in. all positions		
l. Repeat (i), (j), (k), with 3/16"		
m. Repeat (i), (j), (k), with 1/4"		

Operations	Basic Information	References
. Welding cast iron up to 3/8" flat and vertical	a. Characteristics and properties of cast iron	
a. Preparing	b. Identification of cast iron	
b. Preheating	c. Importance of joint preparation	
c. Selecting filler rod	d. Necessity of cleaning metal	
d. Adjusting flame	e. Necessity of pre-heating	
e. Cooling	f. Importance of distortion control	
	g. Purpose of flux	
	h. Correct filler rod	
	i. Correct flame	
	j. Supporting work	
	k. Post-heating	
	l. Cooling slowly	
Welding cast steel - all positions	a. Identification of cast steel	
a. Building up edges	b. Characteristics and properties of cast steel	
b. Filling holes	c. Importance of clean puddle	
	d. Method of building up edges	
	e. Correct filler rod	
	f. Filling holes	
	g. Cooling slowly	
	h. Pre-heating and post-heating	

UNIT IV - WELDING NON-FERROUS METALS - 40 HOURS

Contents

1. Welding aluminum and aluminum alloys (20 hours)
2. Welding copper and copper alloys (10 hours)
3. Welding zinc and zinc-base die castings (10 hours)

Operations	Basic Information	References
. Welding aluminum and aluminum alloys - up to $\frac{1}{4}$" (flat and vertical)	a. Identification of aluminum and its alloys	
	b. Characteristics and properties	
	c. Metallurgical effects of welding	
	d. Necessity of using flux and post cleaning	
	e. Joint design	
	f. Selection of filler rod	
	g. Necessity of cleaning metal	
	h. Weldability of different alloys	
	i. Reducing flame	
	j. Torch angle	
	k. Temperature identification	
Welding copper and copper alloys such as brass and bronze (flat) 12 gauge	a. Identification	
	b. Characteristics and properties	
	c. Weldability of copper and various alloys	

Operations	Basic Information	References
	d. Joint design	
	e. Selection of filler rod	
	f. Purpose of flux	
	g. Post welding treatment	
	h. The zinc problem in welding brass	
Welding zinc and zinc - base die castings (flat)	a. Identification of zinc and white metal	
	b. Characteristics and properties	
	c. Purpose of flux and its removal	
	d. Selection of filler rod	
	e. Importance of ventilation	
	f. Using spatula	
	g. Backing material	

T V - BRAZEWELDING AND BRAZING - 30 HOURS

Contents

1. Brazewelding mild steel, cast iron, malleable castings (20 hours)
2. Brazing with silver alloys (5 hours)
3. Brazing aluminum alloys (5 hours)

Operations	Basic Information	References
. Brazewelding mild steel, cast iron, malleable castings	a. Review 12 - 4 - 1, a to i	
a. Up to $\frac{1}{4}$" butt, lap, fillet in all positions		
. Brazing with silver solder	a. Definition of brazing	
	b. Characteristics and properties of silver brazing alloys	
	c. Importance of cleaning metal	
	d. Importance of joint design	
	e. Flux as heat indicator	
	f. Flame setting	
	g. Strength of brazed joints	
	h. Flux for different types of silver brazing alloys	
	i. Conductivity of brazed joints for elect conductors	
	j. Selection of silver brazing alloy	
	k. Science: Capillary action	

Operations	Basic Information	References
. Brazing aluminum alloys - (flat, vertical, horizontal, butt, fillets, lap)	a. Aluminum alloys possible to braze b. Characteristics and properties of aluminum brazing alloys c. Necessity of using flux and its removal after welding d. Trenching e. Flame adjustment f.. Goggle lenses	

ELECTRIC ARC WELDING

NIT VI - INSTALLING AND USING WELDERS - 16 HOURS

Contents

1. History of electric arc welding (1 hour)
2. Using DC welder (electric motor driver) (5 hours)
3. Using AC transformer welder (5 hours)
4. Using DC rectifier welder (5 hours)

Operations	Basic Information	References
Discussion	a. Review 12 - 5 - 1	
Using DC welder (electric motor driven)	a. Review 12 - 5 - 2 b. Maintenance c. Arc voltage and open circuit voltage d. Remote controls e. Overcoming arc blow	

Operations	Basic Information	References
3. Using AC transformer welder	a. Review 12 - 5 - 3	
	b. Maintenance	
	c. Significance of power factor correction	
	d. Function of capacitors	
. Using DC rectifier welder	a. Review 12 - 5 - 4	
	b. Overcoming arc blow	
	c. Maintenance	

NIT VII - WELDING FERROUS METALS - 92 HOURS

Contents

1. Preparing job and equipment (2 hours)
2. Running a bead (5 hours)
3. Welding sheet metal (20 hours)
4. Welding mild steel plate and low alloy plate (50 hours)
5. Welding steel pipe (5 hours)
6. Welding cast iron (10 hours)

Operations	Basic Information	References
1. Preparing job and equipment	a. Review 12 - 6 - 1	
2. Running a bead	a. Review 12 - 6 - 2	
3. Welding sheet metal - up to 1/8" - all positions - butt, lap, open, corner, fillet	a. Blueprint reading to determine type of weld required	
	b. Size of weld	
	c. Selection of electrode	
	d. Tacking	
	e. Penetration	
	f. Downhand and uphand welding	
	g. Characteristics of a good weld	
	h. Six principle categories of electrodes	
	i. Specifications for electrodes	
4. Welding mild steel plate and low alloy plate - butt, lap, fillet and open corner welds on 1/8, 3/16, 1/4 and 3/8 inches coupons in all positions	a. Review 12 - 6 - 3	
	b. Blueprint reading to determine joint required	
	c. Procedures in all positions	
	d. Hand and machine bevelling	
	e. Different rod angles for different welds	
	f. Use of uphand and downhand welding	
	g. Gravitational effect on appearances of bead	

Operations	Basic Information	References
	h. Points of stress	
	i. Controlling distortion	
	j. Stress relieving	
	k. Preheating and postheating	
5. Welding steel pipe in fixed position 4" up to 8"	a. Blueprint reading to determine details required	
	b. Necessity of material classification	
	c. Weld preparation	
	d. Hand and machine bevelling	
	e. Land thickness	
	f. Analysis and sizes of electrode	
	g. Set up and tacking procedures	
	h. Necessity for penetration	
	i. Welding procedures in all positions	
	j. Reasons for uphand and downhand techniques	
	k. Appearance of finished weld	
	l. Effects of preheating and postheating on grain structure	
	m. Difference between destructive and non-destructive testing	
	n. Necessity of dressing a finished weld	

Operations	Basic Information	References
	o. Different types of passes	
	p. Line-up clamps	
	q. Laying out branches	
	r. Science: application of Ohm's Law in relation to welding positions and machine settings	
Welding Cast Iron - flat, vertical, horizontal up to 3/8"	a. Identify different cast irons	
	b. Characteristics of grey, white and malleable C.I.	
	c. Classification and sizes of electrode	
	d. Preparation of weld	
	e. Arc length	
	f. Machinable cast irons and non-machinable	
	g. Burning C.I. before welding	
	h. When to use cold welding on C.I.	
	i. Preheating and stress relieving - cheap methods	
	j. Sequence of spot heating	
	k. Expansion	
	l. Limitations	

UNIT VIII - SURFACING

Contents

1. Building up surfaces (5 hours)

Operations	Basic Information	References
1. Building up surfaces	a. Importance of identifying metal	
	b. Necessity of knowing purpose of weld	
	c. Preparation of weld area	
	d. Methods of welding with ferritic electrodes	
	e. Using austenitic, martensitic and carbide electrodes	
	f. Proper heat and build-up	
	g. Properties of core wire	
	h. Coated and uncoated electrodes	
	i. Properties of deposit and fluxes	
	j. Pre-build-up mild steel rods	
	k. Finishing weld	

IT IX - CUTTING - 19 HOURS

Contents

1. Cutting mild steel and low alloy steel (10 hours)
2. Cutting mild steel pipe (5 hours)
3. Bevel cutting (2 hours)
4. Cutting cast iron (2 hours)

Operations	Basic Information	References
. Cutting mild steel and low alloy steel-	a. Cutability of metals	
a. Adjusting oxygen and acetylene pressures	b. Types of torches and tips	
b. Lighting and adjusting flame	c. Sizes of cutting tips	
c. Preheating the metal	d. Gas pressures	
d. Starting the cut	e. Angle and distance of flame from work	
e. Restarting a lost cut	f. Starting a cut and speed of travel	
f. Cleaning tips	g. Chemistry of cutting	
g. Cutting round bars	h. Cutting faults and causes	
h. Cutting heavy plate	i. Cutting guides	
i. Cutting rivets	j. Machine cutting	
j. Piercing a hole in plate	k. Rivet cutting nozzles	
k. Stack cutting	l. Tip cleaning and reconditioning	
l. Cutting with gases other than acetylene - natural gas propane (optional)	m. Starting cut in middle of plate	
	n. Automatic shape cutting machines	
	o. Removing slag	
	p. Nozzles for gases other than acetylene	
	q. Controlling distortion in long cuts	
Cutting mild steel pipe	a. Hand cutting to a line	
	b. Machine cutting	
	c. Pipe cutting machines	
	d. Square and bevel cut	

Operations	Basic Information	References
	e. Radial cut	
	f. Starting cut on a pipe	
3. Bevel cutting -	a. Procedure for freehand cutting	
a. Freehand cutting	b. Machine cutting	
b. Machine cutting (optional)	c. Angle of bevel	
	d. Tip size	
	e. Gas pressure	
	f. Position of preheat orifice	
4. Cutting cast iron	a. Methods	

UNIT X - FLAME HEATING AND HEAT TREATING - 20 HOURS

Contents

1. Flame hardening medium carbon steel (10 hours)
2. Flame softening medium carbon steel (5 hours)
3. Forming, bending, straightening by use of heat (5 hours)

Operations	Basic Information	References
1. Flame hardening medium carbon steel	a. Definition of flame hardening	
	b. Necessary equipment	
	c. Correct temperature	
	d. Temperature color chart	
	e. Eliminating distortion	
	f. Effects of elements other than carbon on hardening ability	

Operations	Basic Information	References
	g. Heat treatment of flame hardened parts	
	h. Tempering or drawing	
	i. Use of temperature crayons or tempilstiks	
	j. Flame hardening other ferrous metals	
	k. Spot hardening	
	i. Science: Hardness scales (Rockwell C & B, Brinell, Scleroscope)	
. Flame softening a piece of hardened medium carbon steel	a. Definition of flame softening	
	b. Limitations of this process	
	c. Temperatures required	
	d. Cooling	
. Forming, bending, straightening metals by use of heat	a. Method of heating	
	b. Using templates to obtain certain shapes	
	c. Wrinkle bending pipe	
	d. Using water quench	
	e. Causes of distortion	
	f. Using welding beads for straightening	

UNIT XI - BLUEPRINT READING AND DRAFTING - 30 HOURS

1. Lettering - vertical gothic
2. Alphabet of lines
3. Orthographic projection - freehand sketching
4. Notes and specifications
5. Working drawings to scale using instruments - dimensioned
6. Structural shapes
7. Welding symbols and abbreviations
8. Isometric drawings of models

UNIT XII - METALLURGY - 20 HOURS

Operations	Basic Information	References
1. Industrial tours 2. Films 3. Heat treatment a. Annealing b. Normalizing c. Hardening d. Tempering e. Case hardening	a. Metallurgy of iron: 1. Production of iron from ore 2. Blast furnace 3. Refining 4. Properties of iron ore 5. Tensile strength 6. Fusion b. Identify: carbon steels - low, medium, high cast iron - gray, white malleable aluminum zinc base die cast copper brass c. Alloy steels - classification according to content and uses d. Melting points and their application	

Operations	Basic Information	References

e. Properties of metals - brittleness, malleability, hardness, ductility, elasticity, plasticity, toughness

f. Cast iron - production of gray, white, malleable
- properties
- effect of heat on structure
- difficulties encountered when welding

g. Processes of heat treatment

1. Critical temperature point
2. Formation of ferrite, martensite, troosite
3. Stresses set up during welding
4. Elastic and plastic deformation
5. Residual stresses and stress relieving
6. Arc and acetylene methods compared

WELDING 32 OUTLINE

(Third year of three-year Vocational Welding Program)
(20 credits - 533 hours)

UNIT 1 - USING AND STORING OXY-ACETYLENE EQUIPMENT

Operations

1. Brief review of 22 - 2 - (1 to 8) (5 hours)

UNIT 11 - WELDING FERROUS METALS - 90 HOURS

Contents

1. Preparing job (5 hours)
2. Running a bead (5 hours)
3. Welding sheet metal all positions (10 hours)
4. Welding steel plate all positions (40 hours)
5. Welding pipe (20 hours)
6. Welding cast iron (10 hours)

Operations	Basic Information	References
1. to 4. Review 22 - 3 - (1 - 4)		
5. Welding pipe	a. How to use pipe bevelling machine	
	b. Importance of proper alignment	
	c. Using template for fitting - reasons	
	d. Using contour marker	
	e. Laying out template	
	f. Materials suitable for templates	

Operations	Basic Information	References
	g. Mitre cuts	
	h. Use of backing rings	
	i. Using a square, level and plumb bob	
. Review 22 - 3 - 5 (Cast iron)		

NIT 111 - WELDING NON-FERROUS METALS - 30 HOURS

Contents

1. Welding aluminum and aluminum alloys (10 hours)
2. Welding copper and copper alloys (10 hours)
3. Welding zinc and zinc base die castings - flat (10 hours)

Operations	Basic Information	References
. Review 22 - 4 - 1 (Aluminum)		
. Review 22 - 4 - 2 (Copper and copper alloys)		
. Review 22 - 4 - 3 (zinc)		

IT 1V - BRAZE ELDING AND BRAZING - 40 HOURS

Contents

1. Brazewelding mild steel, cast iron, malleable castings (20 hours)
2. Brazing with silver alloys (10 hours)
3. Brazing aluminum and aluminum alloys (10 hours)

Operations	Basic Information	References
. Review 22 - 5 - 1		
. Review 22 - 5 - 2		
. Review 22 - 5 - 3		

NIT V - SURFACING

Contents

1. Building up surface (30 hours)

    a. Surfacing with bronze
    b. Hard facing
    c. Hard setting

Operations	Basic Information	References
Building up surfaces a. Surfacing with bronze b. Hard facing c. Hard setting	a. Preparation of work piece b. Necessity of build-up prior to hard facing c. Classification of hard-facing materials d. Distortion control e. Cause of deterioration f. "Sweating or tinning" process g. Reason for hard-facing h. Materials normally surfaced i. Purpose of flux j. Factors affecting weld quality	

Operations	Basic Information	References
	k. Annealing hardened steel before hard-facing	
	l. Flame setting	
	m. Metals not possible to hard-face	
	n. Standard sizes and shapes of inserts	
	o. Binding inserts to base metal	
	p. Cooling	

IT V1 - INSTALLING AND USING ELECTRIC ARC WELDERS - 7 HOURS

Contents

1. History (1 hour)
2. Using DC welder (2 hours)
3. Using AC transformer welder (2 hours)
4. Using DC rectifier welder (2 hours)

Operations	Basic Information	References
Review 22 - 6 - 1		
Review 22 - 6 - 2	a. Brief comparison between electric motor driven and internal combustion engine driven	
Review 22 - 6 - 3		
Review 22 - 6 - 4		

NIT Vll - WELDING FERROUS METALS - 109 HOURS

Contents

1. Preparing job (10 hours)
2. Running a bead (6 hours)
3. Welding sheet metal (20 hours)
4. Welding mild steel plate and low alloy plate (53 hours)
5. Welding steel pipe (10 hours)
6. Welding cast iron (10 hours)

Operations	Basic Information	References
Review 22 - 7 - 1		
Review 22 - 7 - 2		
Review 22 - 7 - 3		
Review 22 - 7 - 4		
Review 22 - 7 - 5	a. Various methods used - inert gas, tungsten arc, spot welds, seam welds, resistance, flash butt	
Review 22 - 7 - 6		

IT Vlll - WELDING VARIOUS METALS - 35 HOURS

Contents

1. Welding stainless steel (10 hours)
2. Welding copper and copper base alloys (10 hours)
3. Welding aluminum and aluminum base alloys (10 hours)
4. Welding medium and high carbon spring steel (5 hours)

Operations	Basic Information	References
. Welding stainless steel flat and vertical	a. Necessity of color codes	
	b. Handling stainless steel	
	c. Weldability of stainless steel	
	d. Expansion and contraction of stainless steel	
	e. Selection of electrodes	
	f. Sizes and current carrying capacity of electrodes	
	g. Core wire composition	
	h. Coating composition	
	i. Edge preparation	
	j. Preheating and postheating	
	k. Advantages of stainless over mild steel	
	l. Weld finishing	
	m. Effects of carbon in stainless steels	
	n. Three major types of stainless steels	
	o. Results of too much heat	
Welding copper and copper base alloys - all positions	a. Identifying an alloy	
	b. Characteristics of copper and copper alloys	
	c. Tough pitch copper	
	d. Electrolytic copper	

Operations	Basic Information	References
	e. Dioxidized copper	
	f. Weldability of copper	
	g. Selection of method of welding	
	h. Selection of electrodes	
	i. Preparation of joint	
	j. When to apply heat	
	k. Backing strip	
	l. Carbon arc welding	
	m. Limitations	
Welding aluminum and aluminum-base alloys - (flat and vertical)	a. Identifying the alloy	
	b. Types of effective joints	
	c. Welding positions advisable	
	d. Selection of electrode	
	e. Jigs, clamps and back-up strips	
	f. Cleaning flux from rod end to start arc	
	g. Sound of perfect arc	
	h. Preheating	
	i. Finish of bead	
	j. Arc length and electrode angle	
	k. Edge preparation	
	l. Masking	

Operations	Basic Information	References
. Welding medium and high carbon spring steels - (flat, vertical, horizontal)	a. Metal identification b. Preparation of weld area c. Selection and properties of electrode d. Weld deposit properties e. Welding procedures f. Preheating and postheating g. Effect of carbon content on weld h. Annealing and tempering methods i. Stress relieving j. Expansion and contraction k. Tacking l. Sequence of beads (back step, etc.) m. Effect of hydrogen on weld n. Weldability of different metals	

T 1X - SURFACING - 10 HOURS

Contents

1. Building up surfaces (10 hours)

Operations	Basic Information	References
Review 22 - 8 - 1	22 - 8 - 1 (a to k)	

UNIT X - INERT GAS WELDING (Optional) - 20 HOURS

Contents

1. Welding with shielded tungsten inert gas (T.I.G.) (10 hours)
2. Welding with metal shielded inert gas (M.I.G.) (10 hours)

Operations	Basic Information	References
. Welding with shielded tungsten inert gas (T.I.G.) (flat only) 1/8"	a. Metal identification	
	b. Selection of filler rod	
	c. Properties of filler rod	
	d. Air cooled and water cooled torches	
	e. Shielding gas and cylinders	
	f. Control valves and panels	
	g. Regulators	
	h. Tungsten electrodes	
	i. Water and power supply	
	j. Types of current	
	k. Edge preparation	
	l. Welding procedures in flat position only	
	m.. Preheating and postheating	
	n. Safety	
Welding with metal shielded inert gas (MIG) (Flat only)	a. Blueprint reading to determine type of weld	
	b. Metal identification	
	c. Properties of filler wire	
	d. Clamping and jigging	

Operations	Basic Information	References
	e. Regulators and hoses	
	f. Shielding gases	
	g. Water supply	
	h. Welding controls	
	i. Power source and type of current	
	j. Procedure for flat position only	
	k. Finished weld properties	

UNIT X1 - CUTTING - 25 HOURS

Contents

1. Cutting mild steel and low alloy steel (5 hours)
2. Cutting mild steel pipe (5 hours)
3. Flame cutting metals of poor cutability (5 hours)
4. Bevel cutting (5 hours)
5. Gouging mild steel and low alloy steel (5 hours)

Operations	Basic Information	References
1. Review 22 - 9 - 1		
2. Review 22 - 9 - 2		
3. Flame cutting metals of poor cutability such as: stainless steels cast iron aluminum copper manganese steel	a. Necessity of oscillating the torch b. Reducing flame c. Method of using a waster plate	

Operations	Basic Information	References
	d. Adding steel rod to cutting stream	
	e. Iron powder method	
	f. Flux injection method	
	g. Heat input	
	h. Oxygen lance	
	i. Carbon arc	
	j. Arc air torch	
	k. Plasma arc	
	l. Air pressure	
	m. Electrical power source and heat setting	
	n. Polarity	
	o. Electrodes	
	p. Preheating to reduce hardened zones	
	q. Cutting aluminum by M.I.G. technique using steel wire	
	r. Advantage of arc-cutting certain metals	
	s. Metallurgical, physical and chemical effects	
	t. Warpage and stresses	
	u. Machinability	
	v. Surface conditions	

Operations	Basic Information	References
4. Bevel cutting	a. Review 22 - 9 - 3	
a. Free-hand cutting b. Machine cutting		
5. Gouging mild steel and low-alloy steel	a. Low-velocity gouging tips	
a. By flame b. By arc air	b. Recommended air and gas pressures	
	c. Angle of tip to work piece	
	d. Speed in relation to depth	
	e. Scarfing, hogging	
	f. Progressive and backstep gouging	
	g. Metallurgical and chemical effects	
	h. U-groove preparation	
	i. Using a starting rod	

UNIT XII - FLAME HEATING AND HEAT TREATING - 22 HOURS

Contents

1. Flame hardening medium carbon steel (5 hours)
2. Flame softening medium carbon steel (5 hours)
3. Forming, bending, straightening by use of heat (12 hours)

Operations	Basic Information	References
1. Review 22 - 10 - 1		
2. Review 22 - 10 - 2		
3. Flame shrinking, forming and bending a. Definition of terms b. Taking advantage of expansion and contraction c. Science: co-efficient of expansion d. Review 22 - 10 - 3		

UNIT XIII - TESTING WELDS - 10 HOURS

Contents

1. Testing welds by different methods

Operations	Basic Information	References
1. Testing welds in accordance with CSA standards	a. Knowledge of weld design b. Diagnosis of failures c. Metallurgy of the parent metal d. Size and types of welds specified e. Method of testing (destructive and non-destructive) f. Code requirements: AWS, A.I.S.I., ASME, CSA, API g. Local codes h. Identification of physical characteristics of welds	

UNIT XlV - DEVELOPMENT AND BLUEPRINT READING (40 hours)

Operations	Basic Information	References
1. Surface developments a. Funnel b. Frustrum of cone c. Two-piece elbow d. T joint - same diam. - unequal diam. e. Section views f. Welding symbols g. Structural drawings	a. Parallel lines b. Radial lines c. True lengths d. Basic welding symbols - Specific equipment available for pipe work	

UNIT XV - METALLURGY (20 hours)

Operations	Basic Information	References
	a. Properties of metals - weldability, specific gravity, hardenability, etc. b. SAE. Steel numbering system c. Chemical compositions of steel d. Fatigue failure e. Metal working processes f. Testing and inspection g. Fractures - brittle and ductile	

UNIT XVI - GENERAL (40 hours)

Operations	Basic Information	References
1. Industrial visits	a. Employment possibilities	
2. Constructing group projects	b. Provincial Apprenticeship Program	
3. General repair work	c. Workmen's Compensation	
	d. Unemployment Insurance	
	e. Cost estimating	
	f. All Provincial Code requirements a. Pressure vessels b. Flammable liquid tanks	
	g. Welding ACT regulations	
	h. Need for fostering of originality and responsibility on part of all students	

WELDING REFERENCE BOOKS

Oxy-Acetylene Handbook by Linde Air Products Ltd.

Gas Welding Manual by T. B. Jefferson, Associated Business Counselors

Oxy-Acetylene Welding & Cutting (Airco) Lectures, Air Reduction, New York

Oxy-Acetylene Welding & Cutting (Airco) Exercises, Air Reduction, New York

Arc Welding Instruction Course (Airco), Air Reduction, New York

Arc Welding Theory & Practice by Sacks, Van Nostrand Co.

Electric Arc Welding by Austin, American Technical Society, Chicago

Farm Welding by Parker, McGraw-Hill

Arc Welding Lessons for Farm & School, Lincoln Arc Welding Foundation

Manual of Instructions in Welding & Cutting, Rossi, McGraw-Hill

Units in Forging & Welding by R. E. Smith, McCormick & Mathers

Procedure Handbook-Arc Welding, Lincoln Electric Co. Canada

Welding Engineering by Rossi, McGraw-Hill

Welding Encyclopedia, McGraw-Hill

Welding Metallurgy, American Welding Society

Industrial Metallurgy by Patterson & Bearn, Chapman & Hall Ltd.

Automotive Collision Work by Frazee Bedell Spicer, American Technical Society

Automobile Sheet Metal Repair by R. L. Sargent

Modern Arc Welding Practice by J. A. Oates, George Newnes Limited

New Lessons in Arc Welding, Lincoln Electric Company

Projects in Metal for Home and School Shop, James F. Lincoln Arc Welding Foundation

Metalwork-Technology & Practice, Ludwig, McKnight & McKnight

Bench Work - Machine Shop Series, Delmar Publishers Inc.

Machine Shop - Theory & Practice, Hallett, MacMillan Co.

General Metals - Feirer, McGraw-Hill

Blueprint Reading for Welders, Bennett & Siy, Delmar Publishing

Basic Arc Welding, Griffin & Rodin, Delmar Publishing

Basic OxyAcetylene Welding, Griffin & Rodin, Delmar Publishing

Arc Welding - Basic Manual of Instruction, James F. Lincoln Arc Welding Foundation

Farm Equipment Welding Plans, James F. Lincoln Arc Welding Foundation

Arc Welded Projects for the School Shop, James F. Lincoln Arc Welding Foundation

DATE DUE SLIP

F255

TT 211 A33 1963
ALBERTA DEPT OF EDUCATION
WELDING 12-22-32

39844455 CURR HIST

000017905795

TT 211 A33 1963
Alberta. Dept. of Education.
Welding 12-22-32 :

39844455 CURR HIST

CURRICULUM GUIDE

For Reference

NOT TO BE TAKEN FROM THIS ROOM

EXCEPT WITH LIBRARIAN'S PERMISSION